Cosmic Times: 2006

Cosmic Times is a series of six posters with classroom lessons that trace the development of our understanding of the nature of the universe during the past century.

This edition is the last of the series, with the publication date chosen to encompass the discovery of dark energy, a puzzling new component of our Universe that had been undetected until 1997. Since that first discovery, astronomers have confirmed its presence and its overwhelming abundance in our Universe. This edition discusses some of the most recent pieces of evidence for dark energy and NASA's future plans for pinning down its elusive nature. In so doing, this edition returns to the cosmic microwave background (CMB), and shows a more detailed map of the early Universe as observed by the Wilkinson Microwave Anisotropy Probe (WMAP). In addition, the Nobel Prize is awarded to the pair of scientists responsible for the two main science results of COBE, which we introduced in the 1993 *Cosmic Times*.

The language in the 2006 newspaper mimics the style of writing of newspapers of today. Hence, it should be easier to read than previous editions; though, the concepts continue to get harder. We have taken some creative license to make the newspaper more readable in a classroom setting.

The *Cosmic Times* website, http://cosmictimes.gsfc.nasa.gov/, provides a complete teacher guide for this poster and the accompanying lessons. There you can also find two newsletter versions of the poster: one of the newsletters contains the same text as the poster, while the other translates the text to a slightly lower reading level. The web site also includes a glossary. We provide here a summary of the articles, a synopsis of the lessons, and two of the lessons.

Summary of the Articles

(for more information, see
http://cosmictimes.gsfc.nasa.gov/2006/guide/teachers_guide.hml)

Faster Walk on the Dark Side

Recent observations have confirmed the 1997 discovery that the Universe is expanding at an increasing rate. The energy from this accelerated expansion makes up nearly 75% of the energy and matter in the Universe. This article describes the latest evidence for this "dark energy".

Seeds of Modern Universe

NASA's Wilkinson Microwave Anisotropy Probe (WMAP) has picked up where COBE (featured in the 1993 edition of *Cosmic Times*) left off by providing a more detailed baby picture of the Universe, with the seeds of modern structures finally coming through.

Biggest Mystery: What is Dark Energy?

The nature of dark energy is still a puzzle, with several theories in current contention, including the cosmological constant and quintessence. This article describes astronomers' attempts to understand this mysterious energy.

Sorting Out the Dark Stuff

This article clarifies the difference between two very different unseen components of the Universe: "dark energy" (seen as a speeding up of the expansion of the Universe), and "dark matter" (a type of matter whose effects we see gravitationally).

"First Light" Wins Nobel

The scientists responsible for the Cosmic Microwave Background Explorer (COBE), which produced the first detailed spectrum and map of the cosmic microwave background, are honored with the Nobel Prize for physics.

Journey to Cosmos' Dark Heart

NASA plans to study the nature of dark energy in more detail by collecting data for ever-more-distant supernovae. This article describes the three satellite missions which are currently being considered.

Summary of 2006 Cosmic Times Lessons

Each of the lessons uses elements of the 5E model of Engage, Explore, Explain, Elaborate, and Evaluate. These lessons may be downloaded from
http://cosmictimes.gsfc.nasa.gov/2006/2006.html

Measuring Dark Energy (grades 11-12)
Students simulate an experiment in which the discovery of dark energy can be made by plotting modern supernova distances on a Hubble Diagram. Through analysis of astrophysics data, students find that distant objects do not behave the same as closer objects.

Tools of the Trade (grades 9-12)
Students research existing or proposed observatory to learn about its instruments and the questions astronomers seek to answer. Using this information, the students develop a proposal that will be presented to the class. The class controls funding and decide if they feel the project is well defended and worthy of funding.

Things are Not What They Seem (grades 7-12)
Students explore a discrepant event by designing experiments to test what makes a "come-back can" return or why UV beads change color. The process of scientific investigation can change mystifying magic into clear concepts.

Century Timeline (grades 7-12)
Students create a timeline of world events from 1905 through 2006, the years encompassed by the *Cosmic Times* posters and discoveries, to get a sense of the history surrounding the discoveries over the past century. This lesson is provided below.

Cosmic Times 2019 (grades 7-12)
Celebrate the 100th anniversary of *Cosmic Times* by having students write the 2019 edition. Students use information from the 2006 edition to predict the next discoveries that will shape our understanding of the nature of the expanding Universe. This lesson is provided below.

Century Timeline

Suggested Grade Level(s): 7-12
Estimated class time: 2 to 5 class periods depending on how much detail and information you put on the timeline. 2 periods would be sufficient to locate and post science events for each decade and still give time for discussion of the events. Up to a week of class time would be needed for groups to locate events in every strand of the timeline and report out to the class.

Summary

Students will create a timeline of the world events from 1905 until 2006. Students will find key dates from the *Cosmic Times* poster series and world events that fit into the three strands of *Cosmic Times* and into categories of Science, Culture, and World Events/Politics.

The story strands are the Expansion of the Universe/Nature of the Universe, Size of the Universe and the Nature of Supernova.

The timeline will allow students to see how the technology and the data that scientists have used over the past 100 years have brought together the information and cosmological knowledge we have today. Students will also see the place of scientific discoveries and theories in world events.

Objectives

- Students will describe the scientific breakthroughs that trace our understanding of the nature of the universe, ending with the discovery and implications of Dark Energy.
- Students will trace the strands of the *Cosmic Times* posters from 1916 when Einstein presented his theory of General Relativity to the present day by determining the key dates of what was presented.
- Students will relate the findings in science to world events in areas of culture, world events and politics.
- Students will research and present their findings to their classmates.
- Students will view scientific discoveries as one strand in world history.
- Students will identify the key discoveries, breakthroughs, theories, and concepts that altered our view of the universe.

National Science Education Content Standards

NS.5-8.7, NS.9-12.1 SCIENCE AS INQUIRY
NS.9-12.4 EARTH AND SPACE SCIENCE
- Origin and evolution of the universe

NS.5-8.7, NS.9-12.7 HISTORY AND NATURE OF SCIENCE
- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

Knowledge Prerequisite

Students should have read the *Cosmic Times* newspapers.

Teacher Background

It is suggested that teachers be familiar with the content of all of the *Cosmic Times* newspapers, including the teacher notes and be familiar with the website http://hyperhistory.com

Materials

- *Cosmic Times* (newsletter versions and preferably the poster)
- Computers or library for research
- Colored index cards – one color for each strand that is being researched and presented to the class.
- A timeline divided into decades or time periods for as much time as the class is researching.
- Some photographs or drawings representing key events in the last decade – include at least one scientific photograph.

Procedure

I. Engagement

Hold up a photograph or drawing of a key event over the last century.
- Ask students what is different from today.
  {Students may notice clothing, transportation, etc.}
- Ask students what they think is happening.
  {Students may be able to determine key events in history – a World War, a classic movie, a rocket launching, or something familiar from their parents or grandparents time.}
- Ask students how they might find out more about this time period.
  {Books, library, etc}
- If students are not familiar with *Cosmic Times*:
  Explain to them that *Cosmic Times* is a series of posters that are made to be the front page of a newspaper in six different years. These years were chosen because they were significant in our understanding of our universe.
- Tell students that by the end of this lesson they will have a timeline of key events in science and the world.
- Explain that they will research events as a group and prepare cards to place on the timeline.
- Explain that they will tell their classmates about their findings in a discussion period at the end of the time.

II. Exploration

1. Give each group a of students different edition of *Cosmic Times* newsletter version.
2. Ask students to read it and talk to the text by underlining key passages, circling words that need definitions and designating which events are important in this edition of the newsletter.
3. As a group the students will make a list of what scientific discoveries need to be on the timeline.
   a. Students will research these events and find the dates when they occurred.
   b. Students will then divide these events into the three strands (Expansion of the Universe/Nature of the Universe, Size of the Universe and the Nature of Supernova)

   Appendix A, available with this lesson on the *Cosmic Times* web site, provides examples of key events that students may find in their research.

III. Explanation

This section of the lesson may be simple or expanded depending on the needs of the class and the time constraints.
- A **simple lesson** would ask for one event for each category below for the time span of the lesson.
- An **extended lesson** will ask for multiple events per decade or even multiple key events per year.

The time may be broken up however it works best for the class.
- Dividing the time by decades works well, but does not correspond to poster years and is useful for a larger number of groups.
- Students can also be assigned times based on the posters in the Exploration section.
- One problem is that **the length of time from poster to poster is not even.**

Suggestions include:
1915 – 1919 for the 1919 poster
1919 – 1935 for the 1929 poster
1935 – 1955 for the 1955 poster
1956 – 1970 for the 1965 poster
1971 – 1993 for the 1993 poster
1994 – present for the 2006 poster.

These times go beyond some posters, but make the number of years more even. An alternative is to assign 2 groups to one poster for 1955 or 1993 – with the groups responsible for different categories.

After students have placed the science of the poster in chronological order they will research and make cards for key events in the areas of other scientific discoveries, culture, and politics/world events.

Color coded cards will help trace the history of each category across the century timeline.

Ask students to write a one or two sentence explanation of the event to share with the other groups for the discussion day.

The teacher may prepare different levels of scaffolding for differentiated learning. Some groups and students will do well with a minimum of direction. Other groups will need some organizational help.

See the Appendix B (available on the *Cosmic Times* web site with this lesson) for suggestions to differentiate this lesson based on ability and some key events that occur during the decades. The events on the timeline in Appendix B are just examples of what students may find in their research and is not meant to be an exhaustive list.

IV. Extension

This section gives students the opportunity to expand and solidify their understanding of the concept and/or apply it to a real world situation

Students may write *Cosmic Times* articles for events that are not in the original posters. These may be a different year or "page two" of the newspaper and may be about science or different topics.

To extend this activity beyond the individual classrooms
Students can work together within their discipline, their grade level or their school to post the timeline along the walls of hallways or a school lobby to involve and inform the entire school. If the timeline could be in place during a time when the community is visiting the school such as conference days or a school concert, community members can view the product as well.

V. Evaluation

As the teacher goes along the timeline, each group in turn will explain their findings to their classmates. One or two sentences maximum to keep the feedback to a reasonable length of time. Students will take notes during the presentations so they can process and synthesize this information.

After viewing the timelines and hearing the presentations, students should identify the key discoveries, breakthroughs, theories, and concepts that altered our view of the universe by writing a one to two page paper based on their notes. This paper should show how the technology and the data that scientists have used over the past 100 years has brought together the knowledge about the universe that we have today.

Cosmic Times 2019

Suggested Grade Level(s)): All Grade levels from 7-12
Estimated class time: 5-10 class periods (1-2 weeks); This project can be done in a week or can be carried out for two weeks depending on how much time the teacher would like to students to put into it.

Summary

The students will use the 2006 edition of the *Cosmic Times* articles as well as their knowledge of the universe to write a future 2019 edition of the *Cosmic Times*. This edition will mark the 100th anniversary of the *Cosmic Times* newspaper because the first edition was released for the year 1919. The students should create a newspaper that represents our knowledge of the universe in the year 2019. They should create original, unique ideas that occurred up to and including the year 2019 to show what new theories and ideas scientists and the universe have brought us.

Objectives

- Students will use the data, technology, and information from the 2006 edition of *Cosmic Times* to show how we have come to the current knowledge we have of the universe.
- Students will write articles to describe their predictions of what the state of our understanding of the Universe will be in 2019 *Cosmic Times*.

National Science Education Content Standards

NS.5-8.7 & NS.9-12.7 HISTORY AND NATURE OF SCIENCE
- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

Knowledge Prerequisite

The students should have read the 2006 *Cosmic Times* and be able to interpret information from that poster (or newsletter). The students should also be familiar with the general universal concepts from space science.

Teacher Background

The teacher should have knowledge of the different concepts of cosmology, specifically those covered in the 2006 edition of the *Cosmic Times*.

Materials

- 2006 *Cosmic Times* poster and/or newsletters
- Resources for researching cosmological concepts such as the Internet, magazines, etc…
- Microsoft Publisher or a program for creating a newspaper or some other publishing software. A simple word processor, such as Microsoft Word, can be used and students can cut out articles to create their newspaper layout by hand.

Procedure

I. Engagement

Put students into groups. Provide them with the 2006 edition of the *Cosmic Times*. Have them peruse through the articles and come up with a list of the biggest breakthroughs, theories, and concepts discovered by scientists and cosmologists as described in the 2006 *Cosmic Times*. The students should also be encouraged to use any Earth/space science textbooks or other resources to help make a complete list of items. The students will use this list of universal concepts and theories as a basis or starting point for what they will be writing about in their own 2019 edition of the *Cosmic Times*. Students may use the worksheet, available with the online version of this lesson, to guide their ideas.

Once the students have compiled a master list of these important ideas and concepts, break them up into groups. You can assign the students which articles they will be working on, or you can break the groups up according to interest level. For example, some students may have a great interest in dark energy and they can be involved in creating that article; whereas, another group of students may have interest in the Big Bang and want to be involved in creating that article for the newspaper.

II. Exploration

The students should thoroughly research the cosmological idea/concepts that they have chosen. It might be helpful to look at previous editions of *Cosmic Times* to familiarize themselves with the progression of knowledge about that particular idea. They can then use the Internet or magazines such as Scientific American to help extend that research.

III. Explanation

Once the students have successfully researched their topic, they should come up with a creative idea for their article that will be placed in their original 2019 issue of the *Cosmic Times*. The article should include an appropriate title for their topic. The students should also include any pictures, graphs, charts, or illustrations that will help them to create their newspaper.

IV. Evaluation

The students will be graded on their written newspaper article for the *Cosmic Times* 2019 and how well they worked together in the group to create this final product. You can use the rubric provided with this lesson on the *Cosmic Times* web site.

In addition, when grading the projects, note that in 2019 we may still not have concrete answers and facts such as what exactly dark matter and energy really are. Therefore, the students do not necessarily have to give answers or solutions to questions like this in their article, but may write about more of their properties being discovered for example.